
About this manual

This manual is used by the Companion site planner to plan and install the best possible Companion system for the site.

For the basics of Companion site planning, refer to your *Guide to Site Planning*.

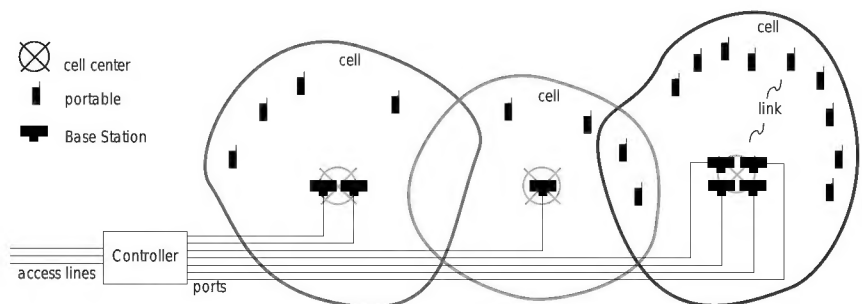
Companion system overview

Introduction to the Companion system

The Companion system allows you to make and receive calls throughout your site using a wireless telephone.

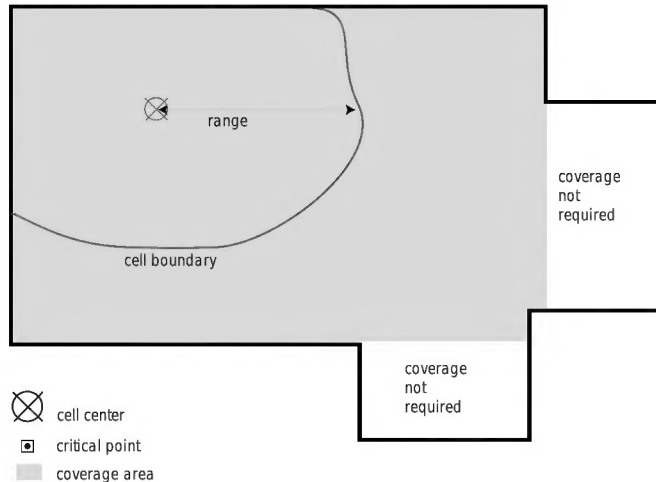
As shown in Figure 1, the basic Companion system consists of a Controller, Base Stations and a portable for each user. The *Controller* provides the connection between the external telephone system, using access lines, and the Companion system, using ports. *Base Stations* relay call information between the Controller and portables. *Portables* are wireless telephones.

Figure 1: The basic Companion System



As shown in Figure 2, the *coverage area* is the part of the site where the customer wants to use their Companion system. The coverage area can be indoors and outdoors.

Figure 2: Coverage terminology



When planning a site for coverage by a Companion system, the outermost points from the center of the coverage area are *critical points*. These points may be difficult to provide radio coverage for so are covered first when planning a site.

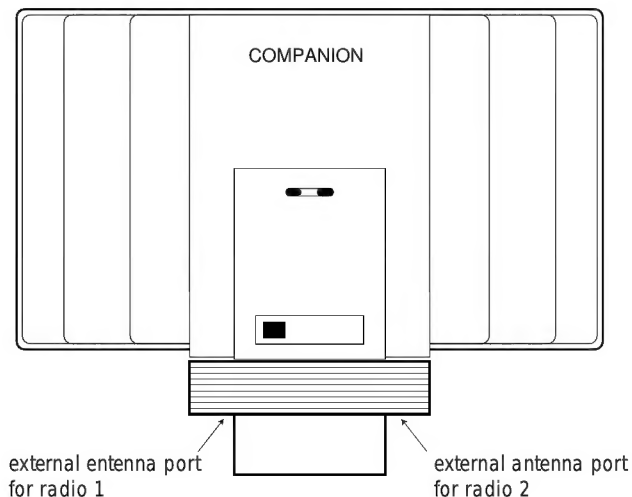
Coverage is provided by grouping Base Stations into *cell centers* throughout the coverage area. A cell center provides telephone coverage to a *cell*. The point where coverage is no longer provided by the cell center is the *cell boundary*. The distance from the cell center to the cell boundary is the *range*.

The radio communication between a portable and Base Station is a *link*. When a user walks from one cell into another, the link is transferred to a Base Station in that cell by a *hand-off* between the two Base Stations. Any portable registered to the system can *roam*, because it can make or receive calls in any cell.

Base Stations

The Base Station, as shown in Figure 3, transmits call information between the Controller and the portable. The Base Station is connected to the Controller using standard telephone wiring. The Base Station uses a wireless connection (radio) to communicate with the portable.

Figure 3: Base Station



Radios and antennas

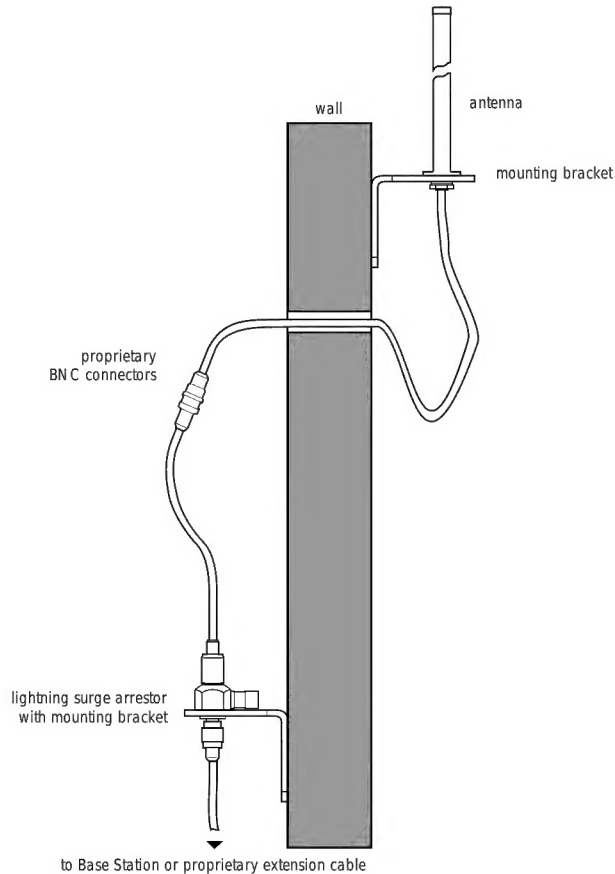
The Base Station has two radios, each with two internal antennas and one external antenna port. Using the two internal antennas one at a time, the radio selects the internal antenna that has the best signal strength. This process is antenna diversity.

The external antenna ports for each Base Station radio can be connected to external antennas by coaxial cables. In this case, the installer configures the radios to use only the external antenna ports and there is no antenna diversity.

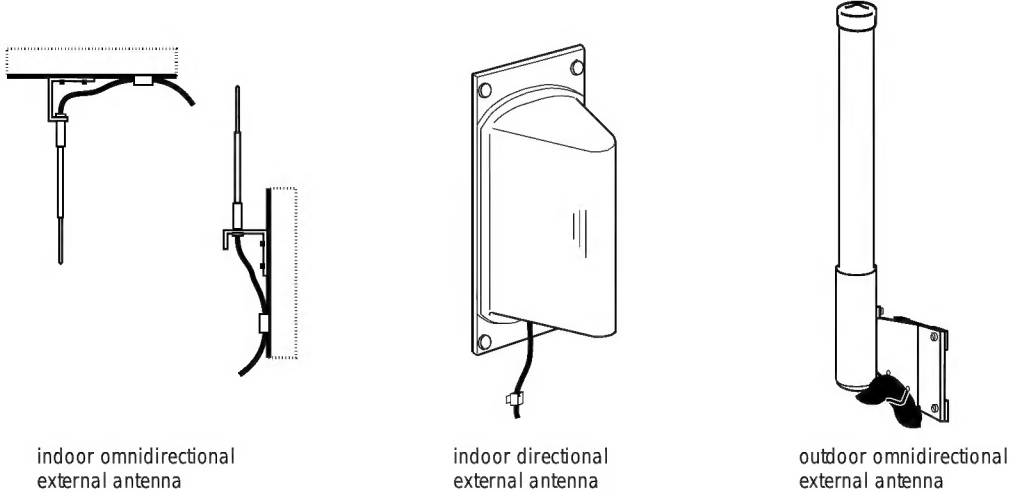
The antenna and lightning surge arrester assembly for PCI is shown in Figure 4.

Several types of antennas for CT2Plus are shown in Figure 5.

Figure 4: Antenna and lightning surge arrester for PCI



Note: The antenna has a gain between -1.2 and 1.5 dBi.

Figure 5: Examples of external antennas for CT2Plus

Note: Not all types of external antennas are available in all countries.

Install external antennas at a cell center as close together as possible, with a minimum distance of 40 in. (1 m). Table 1 shows the pattern and gain of these antennas.

Table 1: External antenna types

Type of antenna	Pattern	Gain
indoor	omnidirectional	0 dB in all directions.
	directional	3 dB in direction of beam, 0 dB at right angles to direction of beam.
outdoor	omnidirectional	2 dB in the horizontal plane. Gain is negative above or below the antenna.

Base Station location

Base Station installation guidelines

- Ensure that the installation complies with your local electrical code.
- Do not plan to install Base Stations in ducts, plenums or hollow spaces that transport air, except where a suspended ceiling creates the duct, plenum or hollow space with lay-in panels or tiles.
- Install Base Stations indoors where there is no condensation and the temperature remains between 32° and 120°F (0° and 50°C). The ideal temperature is between 60° and 95°F (15° and 35°C).
- Install all Base Stations within 4,000 ft (1 200 m) (wiring length for 24 AWG) of the Controller.
- Do not position Base Stations on large concrete or marble columns. Base Stations must be at least 40 in. (1 m) from columns and located at a cell center on the same side of the columns.
- Position Base Stations on ceilings or upright against walls at a height where there is the least number of obstructions between the Base Stations and the cell edge (usually close to the ceiling).

Installing Base Stations on the ceiling has the following advantages over installing Base Stations on a wall:

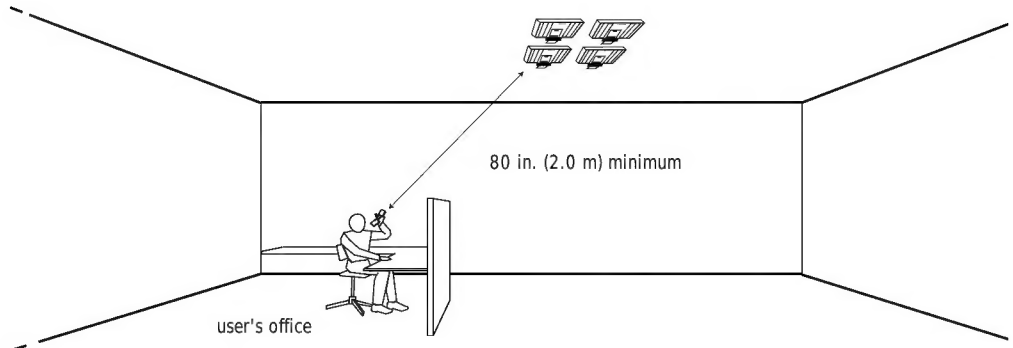
- it is easy for you to keep the Base Stations beyond the minimum distance from where users frequently use their portable, such as in offices
- it gives you more planning flexibility

Install Base Stations on the ceiling unless

- the ceiling has architectural or decorative features that prohibit the installation of Base Stations
 - the ceiling construction prevents you from mounting a Base Station on it
 - the ceiling is made of a material that does not allow you to run wiring to Base Stations mounted on it
 - the customer requests that Base Stations not be mounted on the ceiling
- Position Base Stations away from where a portable is used in an office by at least the amount shown in Table 2, and as illustrated in Figure 6. Installing the Base Stations on ceilings or high on walls helps to maintain these minimum distances.

Table 2: Minimum distance between office areas and Base Stations

Number of Base Stations in the cell	Minimum distance between office areas and Base Stations
1	40 in. (1.0 m)
2	56 in. (1.4 m)
3	72 in. (1.8 m)
4	80 in. (2.0 m)

Figure 6: Minimum distance of portables to Base Stations

Installing multiple Base Stations in a cell center

In cases where there is more than one Base Station at a cell center, follow these guidelines:

- Position all of the Base Stations on the same surface with matching composition.
- Allow a clearance of at least $3\frac{1}{2}$ in. (9 cm) between the Base Stations and surrounding objects.
- Do not position more than four Base Stations in a single cell.

For CT2Plus protocol

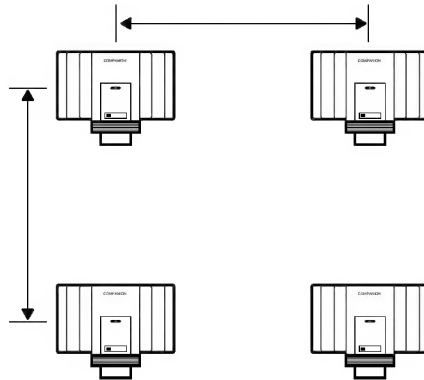
- Position all the Base Stations that are at the same cell center no more than 5 ft (1.5 m) and no less than $3\frac{1}{2}$ in. (9 cm) from each other.
- Position the Base Stations on a ceiling as shown in Figure 7.

For PCI protocol

- Position the Base Stations as close together as possible but maintain a minimum distance of 54 in. (1.35 m) apart (center to center) at the same cell center.
- Do not mount Base Stations in rows.

- If there are three or four Base Stations at the cell center, install them on the ceiling.
- If there are one or two Base Stations at the cell centers, you can install the Base Stations upright on a wall, or on a ceiling as shown in Figure 7.

Figure 7: Base Station positioning



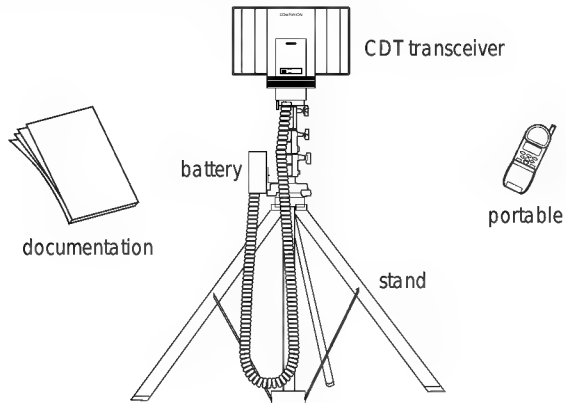
Companion Deployment Tool

Using the CDT

This section describes how you use the Companion Deployment Tool (CDT) to determine cell centers and cell boundaries.

For more information on using the CDT, refer to *Companion Deployment Tool User Guide*.

Figure 8: Companion Deployment Tool



CDT components

The CDT consists of the following components:

- a stand
- a CDT transceiver

Note: The CDT transceiver will not function as a Base Station. You cannot connect it to the Controller.

- a battery inside a battery holder
- a portable
- CDT documentation

When used with the CDT transceiver, the portable continuously displays two values. The signal strength is on the left and the cyclic redundancy check error rate is on the right. The signal strength is the signal transmitted by the portable and received by the CDT transceiver. For an explanation of the cyclic redundancy check, refer to *Companion Deployment Tool User Guide*.

How the CDT works

Refer to *Companion Deployment Tool User Guide* for instructions on assembling the tool, establishing a link, setting the cell boundary value, and choosing the external antenna with the CDT transceiver.

The CDT uses the internal antennas as a default, but this default can be changed to the external antenna. The cell boundary value is the signal strength used with the CDT to determine the cell boundary and can also be changed.

When you have established a link with the portable, enter the numbers as shown in Table 3 into the dialpad to set which antennas and what cell boundary value you want to use.

Table 3: Selecting the CDT antenna and setting the cell boundary value

Entered number	Operation
*894	shows the present selection and setting for 1 second
*895	selects the internal antennas and sets the cell boundary value
*896	selects the external antenna and sets the cell boundary value
*897	sets the cell boundary value

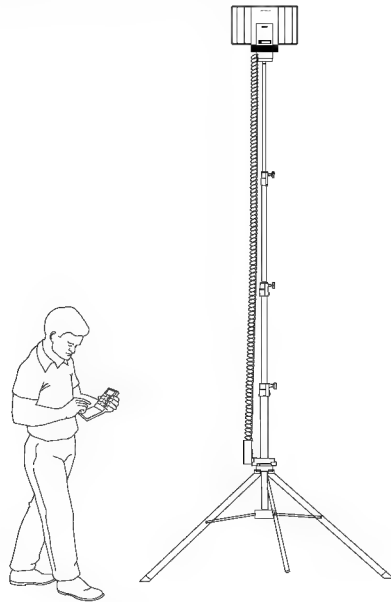
Note: When the CDT transceiver is powered off, the cell boundary value resets to the default value and the internal antennas are selected.

You will hear tones from the portable that indicate the received signal strength. Use the tones to determine the cell boundary. The received signal strength value also appears on the portable's display but the tones should be used to determine cell centers and cell boundaries.

Note: The signal strength on the portable's display uses dBm units.

When you set the CDT transceiver at a critical point, raise the CDT transceiver as high as it can go or until it is at the height that you recommend for Base Stations.

Figure 9: Fully raised CDT



Note: The CDT stand is available in three heights: 8 ft (2.4 m), 12 ft (3.6 m) and 16 ft (4.8 m).

Do not position your CDT transceiver next to large concrete or marble columns. These structures affect the contour of the cell boundary. Keep the CDT transceiver at least 40 in. (1 m) from columns.

Interpreting the portable's tones

The portable makes the following tones to indicate how close you are to the CDT transceiver:

- Steady tone—The signal strength is stronger than the cell boundary value.
- Double beep, followed by a rhythmic high-low tone—The signal strength is weaker than the cell boundary value. The rhythmic high-low tone persists as long as you remain where the signal strength is weak.

- Triple beep, followed by a steady tone—The signal strength has increased to 6 dB stronger than the cell boundary value. The CDT resets for you to make another measurement.
- No sound—If you lose the link, no tones are generated. If you move closer to the CDT transceiver within 10 seconds, the link reestablishes itself.

Conducting a CDT operational check

Charge the battery for the CDT transceiver the day or night before and have a fresh set of batteries for the portable. For details on how to charge the battery, refer to *Companion Deployment Tool User Guide*.

Note: Do not set up the CDT transceiver outdoors. The CDT is not intended for outdoor use.

CDT using CT2Plus protocol

1. Establish a link.
2. In an open area, stand 33 ft (10 m) from the CDT transceiver with the portable. Keep the CDT transceiver in plain view and have no obstructions nearby (including people).

If the display shows -44, the CDT works properly. If the display does not show -44, repeat this procedure with a different portable. If the display still does not show -44, replace the transceiver.

CDT using PCI protocol

1. Establish a link.
2. In an open area, stand 10 ft (3 m) from the CDT transceiver with the portable. Keep the CDT transceiver in plain view and have no obstructions nearby (including people).

If the display shows -35, the CDT works properly. If the display does not show -35, repeat this procedure with a different portable. If the display still does not show -35, replace the transceiver.

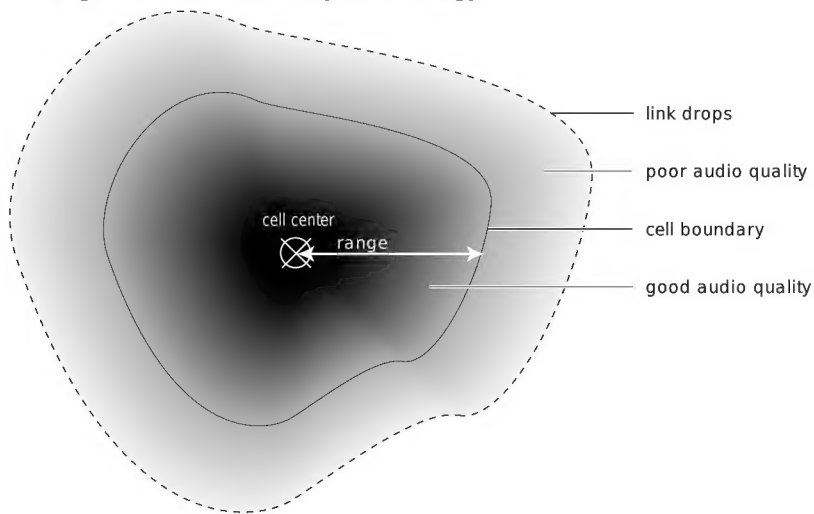
Cell boundary values

The strength of the radio signal the portable receives decreases as you walk away from the cell center. As shown in Figure 10 on page 18, the cell boundary is the farthest place from the cell center where you hear a good radio signal.

Links can be made outside the cell boundary but the audio quality of the link is poor. The link drops when the portable and the Base Station are too far apart.

The range from the cell center to the cell boundary, or the distance to a potential cell center from a critical point, is determined using the cell boundary value and the CDT. The CDT uses a default value for the cell boundary value. This value can be reset to suit your planning needs.

Figure 10: Cell boundary terminology



Use Table 4 to determine which cell boundary value you should use.

Table 4: Cell boundary values

Indoors (with office)	Indoors (without office)	Outdoors
-70 dBm	-73 dBm	-75 dBm

Note: You can set the cell boundary values into your portable. Refer to your portable's user guide for instructions.

Use -73 dBm as the cell boundary value if there are no, or only a few, users' offices within the prospective cell. Use -70 dBm as the cell boundary value if a group of offices is within the cell. Use -75 dBm for outdoor areas that are served by indoor Base Stations. For outdoor areas that cannot be reached by an indoor Base Station, see "Covering outdoor areas" on page 26.

Note: An office is any area where users can make and receive calls on their portables while sitting at their desks or in their cubicles.

Using the CDT to determine cell boundaries

You use the CDT and a portable to determine the radio range. Listen to the tone the portable makes while walking briskly away from the CDT transceiver until the tone changes, indicating the cell boundary value. When the portable detects the cell boundary value, the distance between you and the CDT transceiver is the range. For more information, see "Interpreting the portable's tones" on page 16.

Note: The farther you move away from the CDT transceiver, the more negative the number you read. For instance, a reading of -66 indicates that you are farther from the transceiver than a reading of -50.

Measuring radio range

Note 1: When you are determining the range, hold the portable approximately 40 to 50 in. (1.0 to 1.3 m) from the floor. Do not bring it too close to walls or other objects.

Note 2: Walk briskly as you listen to the tones. This is necessary to get an average reading of the link's signal strength.

1. Stand at a position near the CDT where the portable displays a signal strength that is at least 10 dB stronger than the cell boundary value and where you hear a continuous tone.
2. Walk briskly away from the CDT transceiver until the tone changes. Stop and record your position on the floor plan with a small X.

Note: It is the location where the tone first changes that is important. The signal strength value on the display may fluctuate and the tone may change after you stop walking.